

measured, the measurement technique shall conform to the following:

(1) The air flow measurement method used must have a range large enough to accurately measure the air flow over the engine operating range during the test. Overall measurement accuracy must be ± 2 percent of full-scale value of the measurement device for all modes except idle. For idle, the measurement accuracy shall be ± 5 percent or less of the full-scale value. The Administrator must be advised of the method used prior to testing.

(2) Corrections to the measured air mass flowrate shall be made when an engine system incorporates devices that add or subtract air mass (air injection, bleed air, etc.). The method used to determine the air mass from these devices shall be approved by the Administrator.

(3) Measurements made in accordance with SAE recommended practice J244 (incorporated by reference at § 92.5) are allowed.

(b) *Humidity and temperature measurements.* (1) Air that has had its absolute humidity altered is considered humidity-conditioned air. For this type of intake air supply, the humidity measurements must be made within the intake air supply system, and after the humidity conditioning has taken place.

(2) Humidity measurements for non-conditioned intake air supply systems shall be made as closely as possible to the point at which the intake air stream enters the locomotive, or downstream of that point.

(3) Temperature measurements of engine intake air, engine intake air after compression and cooling in the charge air cooler(s) (engine testing only), and air used to cool the charge air after compression, and to cool the engine shall be made as closely as possible to obtain accurate results based on engineering judgement. Measurement of ambient temperature for locomotive testing shall be made within 48 inches of the locomotive, at a location that minimizes the effect of heat generated by the locomotive on the measured temperature.

(4) Temperature measurements shall comply with the requirements of § 92.105(c).

(5) Humidity measurements shall be accurate within 2 percent of the measured absolute humidity.

§ 92.109 Analyzer specifications.

(a) *General analyzer specifications*—(1) *Analyzer response time.* Analyzers for THC, CO₂, CO, and NO_x must respond to an instantaneous step change at the entrance to the analyzer with a response equal to 95 percent of that step change in 6.0 seconds or less on all ranges used. The step change shall be at least 60 percent of full-scale chart deflection. For NO_x analyzers using a water trap, the response time increase due to the water trap and associated plumbing need not be included in the analyzer response time.

(2) *Precision.* The precision of the analyzers for THC, CO₂, CO, and NO_x must be no greater than ± 1 percent of full-scale concentration for each range used above 155 ppm (or ppmC), or ± 2 percent for each range used below 155 ppm (or ppmC). The precision is defined as 2.5 times the standard deviation(s) of 10 repetitive responses to a given calibration or span gas.

(3) *Noise.* The analyzer peak-to-peak response to zero and calibration or span gases over any 10-second period shall not exceed 2 percent of full-scale chart deflection on all ranges used.

(4) *Zero drift.* For THC, CO₂, CO, and NO_x analyzers, the zero-response drift during a 1-hour period shall be less than 2 percent of full-scale chart deflection on the lowest range used. The zero-response is defined as the mean response including noise to a zero-gas during a 30-second time interval.

(5) *Span drift.* For THC, CO₂, CO, and NO_x analyzers, the span drift during a 1-hour period shall be less than 2 percent of full-scale chart deflection on the lowest range used. The analyzer span is defined as the difference between the span-response and the zero-response. The span-response is defined as the mean response including noise to a span gas during a 30-second time interval.

(b) *Carbon monoxide and carbon dioxide analyzer specifications.* (1) Carbon monoxide and carbon dioxide measurements are to be made with nondispersive infrared (NDIR) analyzers.

(2) The use of linearizing circuits is permitted.

(3) The minimum water rejection ratio (maximum CO₂ interference) as measured in § 92.120(a) shall be:

(i) For CO analyzers, 1000:1.

(ii) For CO₂ analyzers, 100:1.

(4) The minimum CO₂ rejection ratio (maximum CO₂ interference) as measured in § 92.120(b) for CO analyzers shall be 5000:1.

(5) *Zero suppression.* Various techniques of zero suppression may be used to increase readability, but only with prior approval by the Administrator.

(6) *Option:* if the range of CO concentrations encountered during the different test modes is too broad to allow accurate measurement using a single analyzer, then multiple CO analyzers may be used.

(c) *Hydrocarbon analyzer specifications.* (1) Hydrocarbon measurements are to be made with a heated flame ionization detector (HFID) analyzer. An overflow sampling system is recommended but not required. (An overflow system is one in which excess zero gas or span gas spills out of the probe when zero or span checks of the analyzer are made.

(i) *Option.* A non-heated flame ionization detector (FID) that measures hydrocarbon emissions on a dry basis is permitted for petroleum fuels other than diesel and biodiesel; Provided, that equivalency is demonstrated to the Administrator prior to testing. With the exception of temperatures, all specifications contained in Subpart B of this part apply to the optional system.

(ii) The analyzer shall be fitted with a constant temperature oven housing the detector and sample-handling components. It shall maintain temperature with 3.6 °F (2 °C) of the set point. The detector, oven, and sample-handling components within the oven shall be suitable for continuous operation at temperatures to 395 °F (200 °C).

(iii) Fuel and burner air shall conform to the specifications in § 92.112(e).

(iv) The percent of oxygen interference must be less than 3 percent, as specified in § 92.119(3).

(v) *Premixed burner air.* (A) For diesel and biodiesel fueled engines, premixing a small amount of air with the HFID

fuel prior to combustion within the HFID burner is not recommended as a means of improving oxygen interference (%O₂I). However, this procedure may be used if the engine manufacturer demonstrates on each basic combustion system (i.e., four-cycle direct injection, two-cycle direct injection, four-cycle indirect injection, etc.) that an HFID using this procedure produces comparable results to an HFID not using this procedure. These data must be submitted to the Administrator for his/her approval prior to testing.

(B) For engines operating on fuels other than diesel or biodiesel, premixing burner air with the HFID fuel is not allowed.

(2) *Methane analyzer.* The analytical system for methane consists of a gas chromatograph (GC) combined with a flame ionization detector (FID).

(3) *Alcohols and Aldehydes.* The sampling and analysis procedures for alcohols and aldehydes, where applicable, shall be approved by the Administrator prior to the start of testing. Procedures are allowed if they are consistent with the general requirements of 40 CFR part 1065, subpart I, for sampling and analysis of alcohols and aldehydes, and with good engineering practice.

(4) Other methods of measuring organics that are shown to yield equivalent results can be used upon approval of the Administrator prior to the start of testing.

(d) *Oxides of nitrogen analyzer specifications.* (1) Oxides of nitrogen are to be measured with a chemiluminescence (CL) analyzer.

(i) The NO_x sample must be heated per § 92.114 up to the NO₂ to NO converter.

(ii) For high vacuum CL analyzers with heated capillary modules, supplying a heated sample to the capillary module is sufficient.

(iii) The NO₂ to NO converter efficiency shall be at least 90 percent.

(iv) The CO₂ quench interference must be less than 3.0 percent as measured in § 92.121(a).

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